6. Curious curled hairs on front legs.
7. Marmorated thorax.
8. Entirely black, except brownish antennæ and lighter face.

All the species are new except two, one of these being the *D. ampelophila* of Morgan's experiments, the prior name for which is *D. melanogaster* Meigen. One of the new species, *D. similis*, is based on males differing from *D. melanogaster* in lacking the large combs on the front legs, having instead only minute combs which require a high magnification to be seen. In other respects the flies are almost exactly as in *melanogaster*, and in the female sex it is practically impossible to distinguish between the species. There are in addition five females resembling *melanogaster* and *similis*, but differing in a detail of the venation. May we not suppose that *D. melanogaster* was introduced into the Seychelles by man and that *D. similis* and the females (left unnamed) with peculiar venation have arisen from it by mutation since that time? T. D. A. COCKERELL

STERILITY IN A SPECIES CROSS

PROFESSOR J. A. DETLEFSEN, of the University of Illinois, has recently published an interesting paper entitled "Genetic Studies on a Cavy Species Cross."[1] Several wild cavies from Brazil (*Cavia rufescens*) were crossed with domestic guinea-pigs (*C. porcellus*) and a study of the hybrid offspring was continued for seven generations. The experiments were begun in 1903 by Professor Castle who turned them over in 1909 to Professor Detlefsen. They were carried on at Harvard and at the Bussey Institution. The paper is divided into three parts; the first two treat respectively of the genetics of color and coat factors, and growth and morphological characters; the third and most important deals with a study of the sterility of hybrids.

Cavia rufescens differs from the guinea-pig in several characters. In size it is about half as large as the guinea-pig. It has an agouti (gray) coat, but the animal has a darker appearance than tame agouti guinea-pigs, owing to the yellow bands in the ticked hair being much reduced. The belly of the wild species varies from a light yellow to a slightly ticked condition. In agouti guinea-pigs the belly hair is usually yellow with a dark base, but never ticked.

Of the wild stock, only males were used in crossing, on account of the difference in size. All F_1 males from such crosses were

[1] Carnegie Inst. Publication No. 205, 1914.

found to be sterile but the F_1 females were fertile, and the line was continued only by crossing these females with guinea-pig males. Thus with each succeeding generation there was a reduction in the amount of wild blood and the author refers to his hybrids as one half wild, or F_1, one fourth wild or F_2, etc.

As to the inheritance of coat color, the tame agouti coat is dominant over the wild agouti. These two types segregate and are allelomorphic to each other. Each is also allelomorphic to its absence. Detlefsen finds that there is a constant relation between back color and belly color, but this condition is not due to separate factors because they can not be transmitted independently. The two types of tame and wild agouti, he thinks, are perhaps comparable with the types of gray mice described by Cuénot and Morgan, viz., gray-bellied and light- (or white-) bellied agouti. In crosses with non-agouti, the wild agouti type is dominant over black and over red, as in domestic guinea-pigs. After back-crossing the wild agouti colored hybrids with non-agouti for several generations, it is found that the agouti factor is modified, producing a darker coat, in some cases almost black, the ticking being faintly seen only on the belly. Roughness of coat is imperfectly dominant over smooth coat. In later generations it regains its dominance.

In respect to growth and vigor, the F_1 hybrids were heavier at all ages than the guinea-pig parents, and were more vigorous than either parent. These F_1 individuals were crossed with guinea-pigs and gave young which were smaller than the F_1 animals in every way, and in size resembled the guinea-pig parent. The variability of the wild stock in weight and vigor is unknown, but guinea-pigs are remarkably uniform in both respects. In morphological characters, the M-shaped nasal-frontal suture of the wild species is dominant over the truncated nasal suture of the domestic form. The truncated suture reappears in the second generation but does not breed true. As to skull shape, the wild has a pointed head and the tame species a round one. In F_1 a blending occurs, and in later generations the wild pointed head disappears. In the wild cavy a narrow indenture is present on the outer surface of the last upper molar—a character held to be of much importance by systematists. In F_1 this indenture showed to a slight degree, and in subsequent generations was lost.

The section of the paper dealing with sterility is of great interest. No previous investigations on sterility in animals have

been made on such a scale as the experiments reported by Detlefsen. The causes of sterility are very obscure and but little understood. A change of environment and consequent lack of exercise or difference of diet may be a contributing cause of sterility in birds and wild animals in captivity, but none of these influences were operative in Detlefsen's experiments, because the wild cavies from Brazil bred *inter se* under laboratory conditions. Sterility is frequent in hybrids of species not closely related, and it is an axiom among biologists that crosses between different species or genera produce sterile hybrids in one or both sexes. As stated above, all F_1 hybrid males from a cross between a wild cavy male and a guinea-pig female were sterile. However, the F_1 females were fertile and were crossed back to guinea-pig males. These likewise gave in F_2 sterile males and fertile females. Repeated back crosses of fertile females with guinea-pig males produced fertile males in increasing numbers with each generation.

In order to test the fertility of the hybrid males two methods were used: (*a*) breeding tests; (*b*) microscopic examination of spermatozoa obtained by transecting several tubules from the epididymis on one side of the animal. Such an individual could be bred subsequently. In all, 483 males were tested by one or both methods; 50 by breeding alone; 331 by microscopic examination alone; and 102 by both methods. The following table, giving the results of combined microscopic and breeding tests, indicates the value of microscopic examinations in determining the fertility of males:

Microscopic Test	No.	Breeding Test	
		Sterile	Fertile
Without spermatozoa	23	23	
With immotile sperm	11	11	
With few motile sperm	10	9	1
With many motile sperm	58	14	44
	102	57	45

It will be noted that of the 58 males with many motile spermatozoa, 14 proved to be sterile upon breeding. Among these males, Detlefsen attributes the sterility of 9 to external causes, without specifying them, but he can assign no reason for the impotency of the remaining 5. He therefore concludes that

the number and motility of the sperm are not the only essentials for a real fertility, inasmuch as real fertility in the last analysis may mean

the capacity to fertilize eggs and sire young. There are further reasons for concluding that the motile sperm of the hybrid males may be physiologically different from those of the normal guinea-pig, for it often required much more time to obtain young from the hybrid males and the litters were unexpectedly small.

It may be added that sterility was not due to the absence of secondary sexual characters, for all the males were normal in this respect.

The percentage of fertile males in each generation from the back crosses above described, was as follows:

F_1	F_2	F_3	F_4	F_5	F_6	F_7
1/2 Wild	1/4 Wild	1/8 Wild	1/16 Wild	1/32 Wild	1/64 Wild	1/128 Wild
0.0	0.0	14.29	33.32	60.67	69.39	73.33

In the generations having the more dilute wild blood the percentage of fertile males increased. The author holds that some disturbance occurred in the gametogenesis of the males, subsequent to hybridization. The females were normal, but they transmitted this disturbing element to their sons. However, by back-crossing with guinea-pigs this peculiar quality was segregated out. It is evident that if the heredity of fertility and sterility in this case is Mendelian, it is due not to one or two allelomorphic pairs of factors, but to multiple factors. A table is given of the percentages of ultimate recessives expected in back crosses on the basis of various numbers of factors involved. The series for 8 factors, given below, approaches most nearly the percentage of fertile males obtained (see above):

F_1	F_2	F_3	F_4	F_5	F_6	F_7
0.0	0.39	10.1	34.36	59.67	77.58	88.16

The application is somewhat misleading, as the author states, since the probable errors are not given. In each generation the probable error would have to be calculated on the supposition that the females of the preceding generation were normally distributed, otherwise one would have to take into account the error of all the preceding generations. It is improbable that the females of any generation, except F_1, were normally distributed.

He concludes that fertility acts as a very complex recessive character, the results being in accord with the expectations if a number of dominant factors for sterility were present. After these dominant factors were eliminated, there would be produced a fertile recessive type.

BYRON B. HORTON